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LOCAL EQUILIBRIUM THE REACTIVE MAGMA AND EXPERIMENTAL STUDIES OF SILICIC SYSTEMS

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Experimental phase equilibria are being increasingly used for the determination of pre-eruptive conditions of subvolcanic magma bodies. In comparison with mineral-melt thermobarometry combined with analysis of glass inclusions, the experimental approach offers greater sensitivity and accuracy on key parameters such as melt H$_2$O content and pressure. Yet, numerous petrologic studies of silicic volcanic rocks have documented textural and chemical evidence for disequilibrium. Thus, the applicability of equilibrium experiments requires clarification especially in the context of open magmatic systems. It must be recognized that, although bulk equilibrium is generally not attained in silicic magmas, a subsystem of the magma which is in local equilibrium (hereafter designated as the reactive magma) can be typically identified. Reactive magma volumes differ between magmatic systems, yet some generalizations can be made. Reactive magma volumes are much larger in chemically homogeneous than in chemically zoned magma bodies because interstitial melt compositions are homogeneous in the former and heterogeneous in the latter. They can also vary during the lifetime of the magma: remobilization due to mafic magma recharge generates disequilibrium (ie, reduce the reactive magma volume). Reactive magma volumes appropriate for pre-eruptive magma storage differ from (ie, are generally larger than) those appropriate for syn-eruptive magma ascent because conduit processes have much shorter timescales than magma storage processes. These considerations stress the need of a careful choice of the starting composition for the experiments. For pre-eruptive conditions of equilibration of silicic magmas to be reliably determined experimentally, a starting material closely approaching the composition of the corresponding reactive magma must be used. Phase compositions and proportions provide a critical test of the choice of the starting material because both should match simultaneously (for

given P-T-H$_2$Omelt-fO$_2$) in experimental and natural products if the starting material correctly approximates the reactive magma. Certain discrepancies between experimental phase and phenocryst assemblages in recent studies can be explained by differences between experimental and natural P-T-H$_2$Omelt-fO$_2$ conditions, but others likely result from a poor matching between the starting composition and the appropriate reactive magma. The reactive magma concept is thus a useful theoretical tool for the evaluation of the state of chemical equilibrium in silicic volcanic rocks and for the planning and interpretation of experimental studies on silicic magmas.